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Borders and Blood Fractions: Gamma Globulin and Canada's Fight Against Polio, 1950-1955

Dr Stephen Mawdsley

In the summer of 1953, Canadian crews of the light cruiser HMCS Quebec and the aircraft carrier HMCS Magnificent were invited by Canada's Consul General in New York City to donate blood for polio prevention in the United States.¹ An epidemic was raging across the city and dozens of new paralytic cases were being reported each day. The donated blood was to be concentrated into a special antibody-rich serum, known as gamma globulin (GG), and then injected into New York children. When the Canadian navy ships docked, they were met by a mobile American National Red Cross blood unit, which set up on the quarter deck of the HMCS Quebec. While attending New York journalists snapped photographs and described the event as Canada's "gesture of friendship towards their American neighbours," crew members rolled up their sleeves and donated blood in the name of prevention.² This episode raises interesting questions about public reactions to a health crisis during a time of rapid innovation in medical research. What was GG and why did so many Canadians and Americans believe in its potential to prevent polio paralysis before a vaccine? How was Canada's use of GG informed by its southern neighbour and what can a comparative assessment tell us about transnational research and public health practices?

The clinical use of GG in the 1950s was not a new phenomenon, but the product of decades of research. In 1936, Dr Arne Tiselius, a chemist at the University of Uppsala, Sweden, assigned y

(gamma) globulin to the portion of human blood containing antibodies.³ Tiselius' discovery inspired new clinical opportunities, and by the 1940s American researchers adapted his techniques to largescale production.⁴ Dr. Edwin J. Cohn and his team at the Department of Physical Chemistry at the Harvard Medical School developed a centrifugation technique to separate blood into its constituent parts. Applying this process to American National Red Cross blood supplies, medical researchers were able to evaluate GG in a clinical setting and discovered that it could prevent measles and hepatitis.⁵ Although GG varied in potency depending on the blood pool from which it was drawn, it nevertheless conveyed some protection and promised wider benefits in disease prevention.⁶ Before a vaccine was thought possible, the hope that GG might control polio brought Canada and America together as allies against a common enemy.

There is a rich and growing historiography on Canadians' experience with polio. Historians have investigated the accounts of patients and their families, as well as the efforts of nurses and doctors to save lives and ease suffering.⁷ They have also considered Canada's contribution to medical research, the discovery of the Salk and Sabin polio vaccines, and how they were administered to prevent disease.⁸ More recently, scholars have undertaken local and regional studies, highlighting the variation in polio treatment, community response, and immunization uptake.⁹ While this scholarship has improved our understanding of polio, historians have not considered how Canada responded to the clinical availability of GG and what it meant to local communities, as well as what it reveals about the nation's relationship to the U.S. Since both nations were among the first to use GG for polio prevention, this article provides an important comparative assessment of transnational medical practices and influences.¹⁰ It also sheds light on

the nature of scientific collaboration and how national borders and priorities defined the character of mid-twentieth century immunization campaigns.

Drawing on archival sources, medical journals, and historic newspapers, this article argues that the field testing of GG for polio in the U.S. had a considerable impact on Canadians. At a time of anxiety over the rising incidence of polio, many Canadians believed that the blood fraction could prevent paralysis and enthusiastically supported its use. Moreover, as active collaborators with American polio researchers, Canadian scientists had the expertise to implement an independent national GG program, comprising blood collection, processing, immunization, and evaluation. However, far from copying America's health charity model in the fight against polio, Canadians developed a government funded initiative. Despite being an expensive enterprise for a geographically vast and sparsely populated nation, Canada's GG program was extended to tens of thousands of citizens and became an important response to polio before a safe and effective vaccine was licensed. Although the blood fraction was not as effective at preventing polio paralysis as researchers had anticipated, its systematic use reveals how Canadian health leaders drew on transnational relationships to fight disease.

Polio is caused by a virus that can be spread through contaminated objects or surfaces.¹¹

Although most infections are mild with flu-like symptoms, in a small percentage of cases the virus enters the blood stream and targets the motor neurons of the spinal cord.¹² Depending on the severity of the infection, a patient may experience paralysis of the limbs, neck, or respiratory muscles.¹³ Complications arising from paralysis may occasionally lead to death. During the first half of the twentieth century, polio epidemics erupted without warning and usually during warm

weather.¹⁴ Although the virus could infect adults, children were especially vulnerable due to a lack of disease-specific antibodies in their developing immune systems.

Canadians and Americans pursued a range of public health strategies to fight polio before the vaccine. When epidemics emerged, public spaces, such as swimming pools, movie theatres, and schools were closed to reduce the spread of viral contagion.¹⁵ Parents were also encouraged to monitor their children's activities and limit "excessive physical strain and unnecessary travel."¹⁶ Since insects were initially believed to be carriers of the virus, health officials encouraged community clean-up campaigns, as well as fly eradication through the spraying of DDT, a toxic chemical which at the time was believed to be safe for humans.¹⁷ Although communities experimented with a range of public health interventions, polio epidemics continued.

A collective urgency to prevent polio was driven not only by a desire to reduce suffering and fear, but to control clinical and rehabilitative treatment costs. Specialist staff, unique equipment, and years of convalescent therapy were part of many polio patients' recovery. In particular, those with respiratory paralysis required ongoing nursing care and special respirators, known as "iron lungs," to help them breathe.¹⁸ Meanwhile, those with paralysed limbs were treated with hot packs and exercise to help reduce muscle atrophy.¹⁹ Patients, who survived the acute phase of the illness, faced months of physiotherapy and orthopaedic surgery to restore muscles and nerve function. It was not unusual for an individual patient to incur medical costs of \$1000 to \$2000. Although some survivors realized improved mobility from treatment, most had to adapt to lasting paralysis and a prevailing social stigma.²⁰

Funding for polio care and research differed by nation. America's response was shaped primarily by the National Foundation for Infantile Paralysis (NFIP), a health charity established in 1938 by President Franklin D. Roosevelt and his law partner, Basil O'Connor.²¹ The NFIP raised funds through public donations to the annual March of Dimes campaign, which covered the costs of polio treatment, health education, and medical research.²² County chapters of the NFIP worked with doctors and families to help pay for hospitalization costs. By contrast, Canada's response was shaped by a mixture of private and public healthcare. The federal government provided grants to a small number of Canadian scientists embarking on virus research. Meanwhile, the enactment of public hospital insurance in Canada, first in Saskatchewan in 1947, Alberta and British Columbia in 1950, and nationally in 1957, covered some of costs associated with polio treatment, but it did not cover all expenses. Canadian families were encouraged to purchase polio insurance to protect against the costs of ambulance transportation, special nursing, and equipment for long-term care.²³

Due to geographical proximity, shared concerns, and historical alliances, Canadians and Americans collaborated on polio research.²⁴ Dr Robert Defries, director of Canada's Connaught Medical Research Laboratories at the University of Toronto, encouraged polio research at the lab and was an advisor to the American NFIP.²⁵ His head of virus research, Dr Andrew J. Rhodes, also served as an advisor on the NFIP Committee on Immunization and was a regular attendee at U.S. virus research gatherings.²⁶ In turn, U.S. scientists visited Canada and worked closely with federal and provincial health officials on epidemiological studies, virus propagation techniques, and health education.²⁷ Although findings were shared, the direction and funding of polio treatment and research were defined by national borders.

Collaboration in research yielded important results when GG was evaluated for the prevention of paralytic polio. In 1950, the NFIP funded University of Pittsburgh researcher Dr William McD. Hammon to assess the efficacy of GG for polio.²⁸ Hammon did not believe GG would entirely prevent polio, but was convinced it would prevent paralysis by boosting the immune system.²⁹ Although his Pittsburgh rival, Dr Jonas E. Salk, was working on an alternative approach to polio prevention, the concept of a safe and effective vaccine had yet to be proven.³⁰ GG appeared to be a practical, safe, and expedient solution for preventing the worst effects of polio. At a meeting of the NFIP Committee on Immunization, Hammon and senior NFIP officials pressed assembled medical researchers to support a clinical trial of GG for polio. Canada's Dr Rhodes was present at the meeting and joined a unanimous vote approving the study.³¹

With economic, logistical, and marketing support from the NFIP, Hammon carried out a series of GG clinical trials in the states of Utah in 1951, followed by Texas, Iowa, and Nebraska in 1952.³² The blood fraction was administered as part of a randomised controlled trial, in which half of the volunteered children received an injection of GG in the gluteus maximus, while the other half received a similar dose of gelatine solution. Over 50,000 children participated in the experiment and after reviewing the dataset, Hammon and his team concluded that GG offered temporary protection against paralytic polio. Although they acknowledged the blood fraction had some limitations related to duration of immunity (up to five weeks) and a delayed onset of protection (one week), it appeared to be better than nothing.³³ Hammon's optimistic results were published in a five part series in the *Journal of the American Medical Association*, claiming that GG was a valuable public health tool to combat paralytic polio.³⁴

Reports of GG's demonstrated effectiveness were received in the U.S. with a mixture of hope and relief.³⁵ In response, the NFIP invested millions of dollars in a national GG immunization program. Citizens were encouraged to donate blood to the American National Red Cross for fractionation into GG, which was turned over to the U.S. federal government's Office of Defence Mobilization (ODM) for distribution to epidemic areas.³⁶ When polio outbreaks erupted in America during the summer of 1953, GG became a highly prized substance; indeed, in Montgomery, Alabama, the ODM rushed sixty-seven gallons of GG from the national stockpile to immunize over 30,000 children.³⁷ GG provided hope for communities and an opportunity to participate in public health.

Like Americans, Canadians were optimistic about the protective qualities of GG for polio and were keen to make it available for clinical use. When Hammon's clinical trial results were announced, Canadian observers trumpeted the "miracle medicine from human blood" and that GG had "proven its worth as a preventative."³⁸ Canadian politicians and researchers supported the blood fraction because they had collaborated with American scientists and trusted Hammon's findings. By January 1953, Canada's federal health minister, Paul Martin Sr., himself a polio survivor, set the nation on course to develop a national immunization program.³⁹ During a House of Commons session, Martin claimed that the "reports of studies in the United States on the use of gamma globulin" were "encouraging" and that Canada needed to plan for its use.⁴⁰

As part of Martin's initiative, the Federal Gamma Globulin Advisory Committee (FGGAC) was formed. It brought together leading Canadian researchers and health officials, who were tasked

with planning GG production, distribution, and evaluation.⁴¹ At the first meeting in January, members of the FGGAC discussed the logistical challenges of the proposed program, as well as strategies to anticipate parental demand.⁴² They also built a network of suppliers and partners to help implement the program. The Canadian Red Cross Society, a similar but separate organization to the American National Red Cross, coordinated blood donations, while Connaught Laboratories in Toronto oversaw serum production and bottling. The federal government committed \$150,000 towards the cost of production and extended a grant of \$67,000 to Connaught to purchase blood fractionation equipment from the U.S.⁴³ Since GG was in short supply and there would not be enough to immunize all Canadians, FGGAC members also devised a policy to limit access “to household contacts of paralytic cases” and pregnant women.⁴⁴ Only regions with a high incidence of polio could apply for aid.⁴⁵ Although a restricted public health initiative, the national program promised Canadians the fair allocation of a scarce resource and a measure of hope in the face of impending epidemics.⁴⁶

To justify financial investment in GG and reassess its utility, the Canadian government organized an efficacy study to run parallel with the immunization program.⁴⁷ Part of the rationale for this evaluation was based on Hammon’s candid acknowledgement of GG’s limitations. At a Canadian medical society conference, Hammon admitted that “gamma globulin was my baby and I have to say it wasn’t much good.” He continued: “Gamma globulin was found to be too wasteful and uncertain. We were unable to select the right people who needed it at the right time. It would take an inexhaustible supply to prevent polio and we just haven’t got it.”⁴⁸ Concerned but not dissuaded, Dr G. D. Cameron, the deputy federal health minister, reasoned that it was prudent to gather additional data about GG to inform future policymaking.⁴⁹ Health minister

Martin agreed and assured Canadians that “teams who gathered follow-up information where gamma globulin was administered” were “expected to provide valuable information on which further studies of the effectiveness of the serum can be made.”⁵⁰ Parents were asked to “take a chance” to evaluate GG and “allow some children to get an injection that may prevent polio, but not allow other children to have it.”⁵¹ Through this policy, politicians and health officials attempted to balance parental demand for GG with a need for more evidence.

Canada’s national GG program was launched in the spring of 1953 and was made available to all provinces and territories without cost. The availability of GG for polio marked an important turning point for many citizens. “At last the average Canadian,” asserted one journalist, “can actually form a force against polio. An opportunity we’ve been waiting for, for a long time.”⁵² Among the first regions to receive GG for polio was in the northern city of Whitehorse, Yukon. In early June 1953, over 80 cases of polio were reported across the territory with the highest incidence concentrated in its capital city. “You will probably understand my anxiety caused by this polio situation,” wrote one concerned Yukon resident to federal health officials. “I had never before heard of the disease attacking grownups, as it evidently has here.”⁵³ Respirator patients were flown from Whitehorse to Edmonton, Alberta, for emergency care, while ampules of GG were dispatched from Toronto for injection into vulnerable groups.⁵⁴ The swift response to the appeals from a remote northern Canadian region upheld the ambitions of federal policymakers.

In July, the province of Manitoba became the second region to receive large shipments of GG in response to a serious outbreak.⁵⁵ Winnipeg physician Dr John Alcock remembered the widespread fear: “Any time people had a fever the thought of polio crossed their minds. They

read about it in the paper. People were not concerned with where it came from but with what was going to happen to them.”⁵⁶ Dr M. R. Elliott, provincial deputy minister of health, reminded residents that although supplies of GG were limited, they would be available to household contacts of confirmed cases.⁵⁷

American NFIP officials were impressed by Manitoba’s use of GG and sent Hammon to observe the epidemic and gather data. The city’s deputy health officer, Dr R. G. Cadham, worked closely with Hammon and provided “additional information” about the outbreak.⁵⁸ Hammon was astonished by the severity of the Winnipeg epidemic and mentioned to colleagues that it was “the second highest case rate of poliomyelitis ever to occur in North America in an urban population of over 200,000.” He also observed that local health officials were well versed in data gathering techniques and were the first to undertake a study “of comparative rates among contacts to be reported since gamma globulin” was used for polio. “These data,” Hammon reasoned, “offer the best opportunity available to date to attempt to evaluate the effect of gamma globulin on family contacts of poliomyelitis cases by comparing age specific attack rates of all persons who were injected and those who were not.” Although he admitted that the Winnipeg study “was not planned as an experiment,” only based on a “small number of cases,” and had a “definite bias in the data,” he reasoned that it showed that GG “afforded protection to certain family contacts.” He was pleased with the results, which he believed added “considerable weight to theoretical and experimental evidence previously available.”⁵⁹ For Hammon, data generated in Canada helped to sustain American commitment to GG for polio.

Due to the severity of the Winnipeg epidemic and sustained public demand for GG, by late August supplies of the serum were nearly exhausted.⁶⁰ Civic politicians examined alternative arrangements to increase availability. Indeed, Winnipeg Alderman David Mulligan reasoned that he had “reliable information that the U.S. health system had large quantities of the serum on hand” and that there was a “crying need for the serum in Manitoba.” He encouraged fellow politicians to pressure the federal government to use diplomatic channels. However, Alderman Slaw Rebchuk, health committee chairman, found that there was no “surplus gamma globulin available in the United States” since they were being “used for prevention there.”⁶¹ The optimism generated by the widespread use of GG for polio had created embarrassing shortages that were difficult to resolve.

The Canadian Red Cross Society played an important role in urging citizens to help alleviate the GG shortage. “As Manitobans had used up almost three-quarters of Canada’s supply it is only fair that Manitobans be the ones to replace that supply,” one Red Cross official exclaimed. The Portage Lions Club and the Registered Nurses Association joined forces to canvass the city to “obtain volunteers.”⁶² In Brandon, the Red Cross organized a drive to “collect blood urgently required for production of gamma globulin now being used in combatting polio.”⁶³ Manitobans actively supported the campaign and donated thousands of pints of blood in the belief it would reduce GG shortages.⁶⁴

Capitalising on the desperation surrounding the epidemic, a Winnipeg pedlar began door-to-door sales of a substance he claimed would protect children from polio. When health officials learned of the pedlar’s activity, they warned residents that “someone, not a doctor” was charging \$10 per

millilitre for an injectable substance they suspected was an “adulterated serum” or “possibly water.”⁶⁵ Although the pedlar promoted the serum as authentic gamma globulin (GG), a special antibody-rich fraction of human blood, health officials alerted parents to the risks. “Anyone unscrupulous enough to dupe the public in this way,” exclaimed one health official, “would probably not bother to even sterilize the vials and abscesses or blood poisoning might result. . . . The public are fools if they touch it.”⁶⁶

Faith in GG combined with shortages also led some enterprising druggists and physicians to market private stocks. Dr M. R. Elliott acknowledged that despite federal government control over GG, “small quantities of the serum have been available” in Winnipeg at \$25 per dose.⁶⁷ Some physicians faced ethical dilemmas when selling private supplies. One physician recounted an incident where he advised Mrs. A from an affluent family and Mrs. X on a limited budget. When asked by Mrs. A. whether it was worth paying \$160 for her three children to receive GG, he reportedly said “yes.” However, when a similar question was raised by Mrs. X. as to whether it was worth \$140 to immunize her four children, he was less certain. “For I knew that Mrs. X. lived in a veterans housing development, was valiantly trying to pay off a mortgage, bring up four children decently all on \$2600 a year,” he reflected. While he reasoned that the wealthier mother could afford the investment in temporary polio protection, such a cost appeared irresponsible for a less privileged mother. “How should have I answered Mrs. X.?” He mused: “surely a measure of government control could have avoided this situation.”⁶⁸ For this physician, private sales of GG raised uncomfortable professional issues.

Local MPs and trade unions attempted to intervene in the private sale of GG. Winnipeg South MP, Lloyd Stinson, wrote to the federal government, criticizing its handling of the national GG program. He explained that the many people were upset that the blood serum “could be bought ‘under the counter’ for those who could afford it. “I have it on the word of medical practitioner,” Stinson continued, “that this is a fact.”⁶⁹ In one instance, a father attempted to buy GG for “his polio stricken daughter and was told he could not buy it” despite offering \$30 for an injection.⁷⁰ The Winnipeg Trades and Labour Council wrote to the federal government, demanding that private sales of GG be “prohibited.”⁷¹ During a Council meeting, one union representative recommended that an investigation be undertaken. He explained that it was “disgraceful” and that “Ottawa should be told human lives are not for sale, gamma globulin should be free of charge and distributed by the health authorities.”⁷² Dr Elliott reminded Manitobans that such sales were “perfectly legitimate” and that people who do not qualify for federal allocation can obtain GG “from doctors privately.”⁷³ His views were echoed by the federal health department, which explained that physicians and druggists were entitled to sell supplies that were “available through retailed outlets before government control became effective.”⁷⁴ At a time of crisis, many Manitobans believed that access to GG should be based on a need rather than by class.

When the epidemic in Manitoba subsided by the late autumn, health officers reflected on their experiences. The province administered 11,000 doses of the 27,000 dispensed across Canada.⁷⁵ Dr Elliott was not pleased by the mass enthusiasm and criticized the Canadian media for exacerbating the panic surrounding polio and for contributing to the climate of anxiety. At a speaking engagement at the Bluebird Service Club in March 1954, Elliott claimed that “there had been much higher death rates from tuberculosis or accidents, but these did not get the

prominence in the daily press that polio had.” He continued that only four percent of deaths were related to polio, but “newspapers had created a lot of unnecessary publicity.”⁷⁶ In turn, MP Lloyd Stinson charged the federal government with being poorly prepared and that the national GG immunization program was not a “notable success.” He reasoned that federal health officials met with the outbreak “in much the same way it handled the 1950 Red River valley flood” in its “indecisive manner.”⁷⁷ Although the national program provided Manitobans with access to GG, the shortages and private sales did not contribute to a collective sense of success.

Following the outbreak in Manitoba, the province of Alberta applied for GG supplies after counting over 220 cases of polio and 12 deaths by the end of August.⁷⁸ The Royal Canadian Air Force collected respirators from across Canada for use in Edmonton and at one point the Royal Alexandra Hospital was operating 18 iron lungs. Dr G. M. Little, the city’s medical health officer, labelled the outbreak “fantastic” with more than 50 cases reported in one week and an unusually high number of patients with bulbar polio. Dr Russell Taylor, who served as a physician on the polio wards of the Royal Alexandra Hospital remembered that “the impact on the community was enormous. At least five nurses were among the victims and two of them died . . . one doctor died and another was left hemiplegic [complete paralysis in half of the body].”⁷⁹

The federal government worked closely with Alberta health officials to make GG available to the most vulnerable.⁸⁰ Like Manitoba, a GG shortage developed quickly as local demand for the serum spiked. The Canadian Red Cross was pressed by the federal government to increase production and collect 25% more blood – or an additional 150,000 bottles. The Red Cross urged citizens that that only a national blood drive could “ease parents’ minds across Canada and

particularly Alberta where two serious epidemics have occurred during the past two years.”⁸¹ Out of the critical and immediate need for GG came a call to action.

Canadians willingly donated money and blood to help the national program. “Did you know that it takes one pint of blood to manufacture one injection of gamma globulin to fight polio,” a Raymond, Alberta, newspaper asked its readers. “The blood is supplied by you through your Red Cross.”⁸² Meanwhile, the southern community of Didsbury promoted a donation clinic in at the local Evangelical Church. “At last a promising weapon has been discovered to combat one of the most dreaded disease of our time – POLIO,” the local newspaper explained.⁸³ Part informative, part persuasive, the editors asked readers to become involved in the fight against polio.

“Although the term gamma globulin may be a new phrase to many, actually it is the name applied to one of the substances contained in your own blood.”⁸⁴ Drawing on a sense of patriotism, the editors urged citizens to play their part. “Success of the entire program depends on the support of thousands of individuals – voluntary blood donors to provide the needed weapon – gamma globulin.”⁸⁵ The Red Cross also worked with The Imperial Order Daughters of the Empire (IODE) to organize clinics and funds. In Lethbridge, the local IODE chapter held a three-day clinic with the goal of obtaining 1,000 pints of blood, while chapter members carried out a telephone canvassing campaign to recruit prospective donors.⁸⁶ The national donation campaign touched even the smallest communities, whose residents gave money and blood to fight polio.

The Royal Canadian Legion also actively supported the GG program. One Alberta chapter declared “W” day – or War – on polio.⁸⁷ As part of their initiative, the Legion planned a march

to raise \$100,000 to offset the costs of transporting polio patients to hospitals and “aid doctors and nurses to take special courses.”⁸⁸ The Didsbury branch canvassed rural districts for donations and pledged to cover the hospitalization costs of those who had not resided in the province for at least a year and were not covered by the Department of Health. The Legion also pledged \$10,000 for the procurement of GG for Albertans.⁸⁹

Students at the University of Alberta in Edmonton lent their support to the national GG program. *The Gateway* student newspaper publicized the blood donor clinic held in the Students Union Building and reminded readers that attendance was important.⁹⁰ The Canadian Inter-collegiate Blood Donor competition featured the Corpuscle Cup, awarded to the university with the largest percentage turnout, while the faculties of Engineering and Medicine vied for the Ash Trophy.⁹¹ The editor of *The Gateway* led the campaign under the headline “Think! – Act!”⁹² Drawing on fear of disability, he reminded students that they had the power to help fight the “crippling effects of polio” and that their contribution “could easily mean the difference between a happy, active life and life in a wheel chair.”⁹³

The publicity campaign was successful, and an unprecedented number of university students donated blood.⁹⁴ Over 55% of students donated blood (totalling 1,687 pints) with the faculty of Medicine retaining the Ash Trophy. Moreover, the faculty of Agriculture held the coveted status as the “bloodiest faculty on the campus” with a 104.4% student blood donation rate. The impressive response led Red Cross donor panel organizer, William C. Paulin, to recognize it as “the most successful event held on the campus” and that most of the blood donated “was

processed into gamma globulin” for polio.⁹⁵ The University and its students were committed to the potential of GG as a means to keep polio at bay.

Local and national newspapers used human interest stories to rouse donors. In one article, a young polio patient was photographed standing beside a bottle of blood. “Three-year-old Jeanie, a poliomyelitis patient at the Alberta Red Cross Crippled Children’s Hospital,” the journalist explained “looks at a bottle of blood that could have saved her months of pain and crippling.”⁹⁶ Blood and blood donation had quickly become synonymous with prevention of polio disability. With the cooperation of media outlets, as well as local and national charities, the blood donation program for GG exceeded expectations. By February 1954, the Canadian Red Cross Society had surpassed its commitment to the federal government.⁹⁷ The explicit link between blood donation and GG for polio proved to be an effective strategy, as it made individuals feel that they could participate a larger public health initiative.

While the value of GG was rooted in Hammon’s clinical trial data, evidence gathered in 1953 from Canada’s regional health stations told a different story. In the spring of 1954, the FGGAC reviewed local datasets and found that the “Canadian experience in 1953 was very sketchy.”⁹⁸ Although members believed that there was a “sound immunological basis for the use of gamma globulin,” most concluded that had not been administered at the right time or under the right conditions to be effective.⁹⁹ Dr John F. Mahoney, New York City health commissioner, offered Canadians his opinion that based on 1953 data, GG “isn’t half as effective as you’ve been led to believe.”¹⁰⁰ Like Canadian health officials, Americans were also questioning the value of GG for polio. The U.S. Public Health Service reviewed data for 1953 and concluded that there was “no

evidence” that GG “prevented or mitigated paralytic polio” and “no evidence” that it “was effective when given to family contacts of persons stricken.”¹⁰¹ A study presented at the WHO Conference on Poliomyelitis also reported that “GG was too slow” to take effect and that “no protection was demonstrated during the weeks immediately following inoculation.”¹⁰² The combination of U.S. and Canadian data pointed to an uncomfortable truth about the limited value of GG for polio.

American and Canadian health professionals grappled with the troubling findings about GG and the exorbitant costs associated with continued investment in the programme. At a gathering of district medical health officers in Canada, American researcher Dr Robert Korns discussed the limits of GG for polio. Korns had experience with GG and was a critic of Hammon’s clinical trials. “One of the greatest surprises at the meeting,” a journalist observed, “was the disclosure . . . that gamma globulin is of little or no value in protecting against polio.”¹⁰³ Meanwhile, Dr J. E. Gajewski, associate director of clinical investigations at Parke Davis, attacked the high cost of GG relative to its supposed protective benefits. Drawing on clinical and public health data from the United States, Gajewski showed that the approximate cost to save one person from polio paralysis ranged from \$5,000 to \$27,000. “The reason the cost is so high,” he explained, “is that a large number of people must be given the injection while the incidence of polio is comparatively low.”¹⁰⁴ Collaboration between American and Canadian health professionals brought together evidence that challenged the idea that GG was a practical polio preventative.

In response to rising criticism about GG, some Canadian researchers and politicians attempted to defend the national program. Dr Robert Defries of Connaught Labs explained that “there is no

doubt of the protective value of gamma globulin against poliomyelitis” but that there were some “limitations” which needed to be recognized. He addressed criticism that GG was “useless” by countering that it was proven effective in animal tests and that some immunization failures were because the person “had contracted the disease before the protective gamma globulin had been given.”¹⁰⁵ The Canadian Red Cross Society joined the defence of the national GG program. “Gamma globulin has a definite value in polio prevention,” claimed national commissioner Dr W. S. Stanbury. Although he admitted that GG had limitations, he believed that should not deter Canadians. “The program must continue,” he argued. “Even if we save only a handful of children from the disease, it would be worthwhile.”¹⁰⁶ For some stakeholders, GG was better than nothing and likely offered some protection against polio.

Many Canadian parents were unmoved by public health debates and were committed to GG for polio. In response, federal politicians planned for the continuation and expansion of the national program in 1954. Until a safe and effective polio vaccine was licensed, policy-makers reasoned that they had no choice but embrace existing measures.¹⁰⁷ Federal health minister Paul Martin remained unmoved by debates and was committed to the program, arguing that polio had “assumed new prominence as a major public health problem” and that 1953 was “one of the most serious on record.”¹⁰⁸ Indeed, Canada had witnessed 8,243 cases of polio and 354 deaths by the end of 1953.¹⁰⁹ Martin authorised another \$1.5 million to the provinces under the national health plan and “of this more than \$730,000 was for the extension of research into the value of gamma globulin, for Red Cross blood banks, and for helping at increased production.”¹¹⁰ He explained that GG was “Canada’s health story of the year” and that its distribution was “an outstanding

illustration of effective cooperation.”¹¹¹ Although he warned the public against over-optimism, he acknowledged that GG was the only “known preventative agent” against polio.¹¹²

The FGGAC devised a new plan for GG production and distribution to reduce shortages in 1954. The committee relaxed controls on the serum and expanded private commercial production. In addition to Connaught Laboratories, the American pharmaceutical company Lederle Laboratories (a division of American Cyanamid) set up production of commercial GG in Montreal to provide the serum directly to doctors for private sale.¹¹³ By June, shipments of commercial GG were being sent major cities, including Edmonton, Vancouver, and Winnipeg.¹¹⁴ Winnipeg newspapers reported “City Stores Now Selling Polio Serum” and reminded readers that GG offered “temporary immunity against polio.”¹¹⁵ Although the federal government was the primary supplier of free GG in Canada, the need for increased production created an opportunity for commercial enterprise.

Anticipating demand for GG, the Canadian Red Cross Society revived its blood donation drive. Small town newspapers was asked to run multicolumn features, explaining that blood and monetary donations were still needed as a matter of urgency to help offset the average cost of \$10 to \$40 per dose of GG.¹¹⁶ In a separate photographic feature under the headline “How the Blood Transfusion Service Operates in Saskatchewan,” one newspaper recounted how blood donors in the province were graciously increasing supplies of the precious substance. “It depends on every citizen recognizing his or her personal responsibility by being prepared to donate their blood when required and if able to do so.”¹¹⁷

Although GG production in Canada increased between 1953 and 1954, Canadian health organizations attempted to temper parental expectations. At a meeting in Saskatchewan, Canadian Red Cross Society chairman Dr W. S. Stanbury explained to parents that it was impossible to “protect all children” as GG remained a scarce substance. “If we consider the practicality of injecting 3,000,000 children in Canada with gamma globulin,” he explained, it would require a vast number of donations and “cost the Canadian government \$13,000,000.”¹¹⁸ In turn, the Health League of Canada charged that “over-optimism” towards GG might “result in a tragic curtailment of the material” where it was needed most. Dr Nelles Silverthorne, a paediatrician at the Hospital for Sick Children in Toronto who chaired the Child and Maternal Health Section of the League, explained that GG should only be used in epidemic areas and not given indiscriminately. “It is only fair in non-epidemics areas of all people to cooperate with our present plan of using gamma globulin (already in short supply) to protect possible close contacts in a very heavily infected area where an epidemic is causing severe crippling and death,” he explained.¹¹⁹ Health organizations attempted to set realistic expectations at a time of increased production of GG and uncertainty towards its value for polio control.

As the Canadians greeted the summer of 1954, parental demand for GG clashed with professional judgement. A Toronto mother asked her family doctor to immunize her two children with GG in the hope it would protect them from polio. The doctor refused to comply, stating that the injections were “inadvisable” because the boys did not live in an epidemic area and that any protection would be short-lived. The mother complained to the provincial authorities about the doctor’s refusal. The Health League of Canada defended the doctor, citing that it was “wise, fair,

and thoroughly justified.”¹²⁰ Despite a growing body of scientific evidence refuting the value of GG for polio, parents and the government remained committed to its use.

Although Canada’s national GG immunization program endured scientific debates, serum shortages, and high costs, it was brought to an end in 1955 with the licensing of the first polio vaccine.¹²¹ The vaccine, developed by Dr Jonas Salk and funded by the NFIP, was field tested in 1954 in the United States, Finland, and in the Canadian provinces of Alberta, Manitoba, and Nova Scotia.¹²² Canada’s prior experience with GG and polio research made it attractive to American researchers and approximately 50,000 Canadian children were enrolled in the study to complement the American cohort of over 1.8 million children.¹²³ On April 12, 1955, the field trial results were announced and the Salk vaccine was declared “safe, effective, and potent.”¹²⁴ With the transnational networks and experience generated by the GG immunization program, Canadian officials were prepared to review and license the new polio vaccine. Although GG had not lived up to the expectations of doctors and public health officials, Canadian enthusiasm and investment in the blood fraction was made for reasons of public health pragmatism and politics.

During the early 1950s, Canadians and Americans faced a challenge in the war against polio. Although quarantine measures, fly eradication programs, community clean-up campaigns, and the closure of public spaces promised to reduce the spread of contagion, epidemics continued apace. America’s discovery and field testing of GG for polio was a collaborative effort that had a considerable effect on Canada. Politicians and researchers believed in the efficacy of the blood fraction because they trusted Hammon’s field data and were part of a strong transnational research network. As active collaborators with American polio researchers, Canadians had the

experience and resources to develop an independent national GG program, which unlike the U.S., was government-managed and funded. Canada's national program proved expensive and challenging to implement, but it helped citizens feel empowered and active participants in public health. Although GG did not meet expectations and was replaced by the Salk polio vaccine, its use reveals how Canadian health leaders drew on transnational relationships in a time of crisis.

Notes:

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¹ Culp to Barrows, July 13, 1953, S 3: GG FT, Box 3, SSR, March of Dimes Archives, White Plains, New York (henceforth MDA).

² "A Canadian Gesture of Good Friendship to the U.S.," *The Springfield Leader*, September 29, 1953, p. 1.

³ Arne Tiselius, "Electrophoresis of Serum Globulin, II. Electrophoretic Analysis of Normal and Immune Sera," *Biochemical Journal* 31, 9 (September 1937): 1464-1477; Charles A. Janeway, *The Gamma Globulins* (Boston: Little, Brown, and Company, 1966), p. 2.

⁴ Angela Creager, "'What Blood Told Dr Cohn': World War II, Plasma Fractionation, and the Growth of Human Blood Research," *Studies in History and Philosophy of Biological and Biomedical Sciences* 30, 3 (1999), p. 379; Douglas M. Surgenor, *Edwin J. Cohn and the Development of Protein Chemistry: With a Detailed Account of His Work on the Fractionation of Blood During and After World War II* (Cambridge: Harvard University Press, 2002).

⁵ J. Stokes, Jr. and J. R. Neeffe, "The Prevention and Attenuation of Infectious Hepatitis by Gamma Globulin," *Journal of the American Medical Association*, 127 (January 1945): 144; J. Stokes Jr., E. P. Maris, and S. S. Gellis, "Chemical, Clinical, and Immunological Studies on the Products of Human Plasma Fractionation. XI. The Use of Concentrated Normal Human Serum Gamma Globulin (Human Immune Serum Globulin) in the Prophylaxis and Treatment of Measles," *The Journal of Clinical Investigation* 23, 4 (July 1944): 531-540.

⁶ Stephen E. Mawdsley, *Selling Science: Polio and the Promise of Gamma Globulin* (New Brunswick: Rutgers University Press, 2016), Chapter 1.

⁷ Christopher J. Rutty, "'Do Something!... Do Anything!': Poliomyelitis in Canada, 1927-1962" (Ph.D. Thesis, University of Toronto: 1995); Christopher J. Rutty, "The Middle-class Plague: Epidemic Polio and the Canadian State, 1936-37," *Canadian Bulletin of Medical History* 13, 2 (Fall 1996): 277-314; Geoffrey Reaume, "Disability History In Canada: Present Work In The Field And Future Prospects," *Canadian Journal of Disability Studies* 1, 1 (2012): 35-81.

⁸ Christopher J. Rutty, Luis Barreto, Rob Van Exan, Shawn Gilchrist, "Conquering the Crippler: Canada and the Eradication of Polio," *Canadian Journal of Public Health* 96, 2 (Mar/Apr 2005); Susan L. Smith and Stephen Mawdsley, "Alberta Advantage: A Canadian Proving Ground for American Medical Research on Mustard Gas and Polio in the 1940s and 1950s," in Erika Dyck and Christopher Fletcher eds., *Locating Health: Historical and Anthropological Investigations of Place and Health, Studies for the Society for the Social History of Medicine* (London: Pickering & Chatto Publishers Ltd., 2010): 89-106.

⁹ Russell F. Taylor, *Polio '53: A Memorial for Russell F. Taylor* (Edmonton: University of Alberta Press, 1990); Gillian Liebenberg, "Disease and Disability: Poliomyelitis, Rehabilitation and Social Reform for Disabled Persons in New Brunswick, 1941-1955," (MA thesis, University of New Brunswick: 1994); Christopher J. Rutty, "'Helpless:' The 1951 Ontario Polio Outbreak - The Neil Young Case" in A. Jenkins (ed.), *Neil Young and Broken Arrow: On a Journey Through the Past* (Mid Glamorgan, Wales: Neil Young Appreciation Society, 1994); Megan J. Davies, "Competent Professionals and Modern Methods: State Medicine in British Columbia during the 1930s," *Bulletin of the History of Medicine*, 76, 1 (Spring 2002): 56-83; Edmond Potvin, "Étude préliminaire sur l'épidémie de poliomyélite de l'été 1954, dans la région du Saguenay-Lac-Saint-Jean," (Québec: Université Laval); Joy Jaipaul, "In the Shadows: Poliomyelitis Epidemics and Nursing Care in Edmonton 1947-1955," *Alberta History*, 53, 3 (Summer 2005); Liza Piper, "Chesterfield Inlet, 1949, and the Ecology of Epidemic Polio," *Environmental History* 20, 4 (1 October 2015): 671-698; Karen K. Yoshida and Fady Shanouda, "A Culture of Silence: Modes of Objectification and the Silencing of Disabled Bodies," *Disability and Society* 30, 3 (April 2015): 432-444.

¹⁰ Susan L. Smith, *Toxic Exposures: Mustard Gas and the Health Consequences of World War II in the United States* (New Brunswick: Rutgers University Press, 2017).

-
- ¹¹ Jane S. Smith, *Patenting the Sun: Polio and the Salk Vaccine* (Morrow, New York, 1990), Chapter 1 and 2.
- ¹² John R. Paul, *A History of Poliomyelitis* (New Haven: Yale University Press, 1971), p. 7.
- ¹³ David Oshinsky, *Polio an American Story* (New York: Oxford University Press, 2005), Chapter 1.
- ¹⁴ T. Francis Jr., R. Korn, R. Voight, M. Boisen, F. Hemphill, J. Napier, et al. "An Evaluation of the 1954 Poliomyelitis Vaccine Trials: Summary Report," *American Journal of Public Health* 1955; 45(suppl): 1–50.
- ¹⁵ "Spread of Polio Causes Dual Ban," *Didsbury Pioneer*, August 19, 1953, p. 4.
- ¹⁶ "Doctor Outlines Eight Rules to Combat Poliomyelitis," *Gleichen Call*, August 6, 1952, p. 2.
- ¹⁷ Oshinsky, *Polio: An American Story*, p. 70; "Houseflies Can Be Controlled," *Didsbury Pioneer*, August 8, 1951, p. 6.
- ¹⁸ Oshinsky, *Polio an American Story*, Chapter 1.
- ¹⁹ Naomi Rogers, *Polio Wars: Sister Kenny and the Golden Age of American Medicine* (New York: Oxford University Press, 2013).
- ²⁰ Oshinsky, *Polio an American Story*, Chapter 1.
- ²¹ Victor Cohn, *Four Billion Dimes* (Minneapolis: Minneapolis Star and Tribune, 1955), p. 55.
- ²² Sills, *The Volunteers* (Glencoe: Free Press, 1957), p. 170.
- ²³ *Crossfield Chronicle*, January 5, 1951, p. 3; *Didsbury Pioneer*, August 13, 1952, p. 2.
- ²⁴ Smith and Mawdsley, "Alberta Advantage" in *Locating Health*.
- ²⁵ Editorial. "Dr. R.D. Defries Retires," *CMAJ* 73 (Aug. 15, 1955): 300-01.
- ²⁶ A. J. Rhodes, 'Research On the Development of a Poliomyelitis Vaccine: Toronto, 1950-1953,' *CMAJ* 75 (July 1, 1956): 48-49.
- ²⁷ Dr Thomas Francis, Jr. Collection, Box 17, Bentley Historical Library, Ann Arbor, Michigan; Government Relations (Foreign), Box 1, March of Dimes Archives, White Plains, New York.
- ²⁸ Mawdsley, *Selling Science*.
- ²⁹ Mawdsley, *Selling Science*.
- ³⁰ Jane S. Smith, *Patenting the Sun: Polio and the Salk Vaccine* (New York: William Morrow, 1990).
- ³¹ Mawdsley, *Selling Science*, p. 34.
- ³² "New Discovery Hoped to be Polio Protection," *Winnipeg Free Press*, September 27, 1951, p. 14.

³³ Mawdsley, *Selling Science*, Chapters 2 and 3.

³⁴ Hammon, W. M., L. L. Coriell, and J. Stokes Jr. "Evaluation of Red Cross Gamma Globulin as a Prophylactic Agent for Poliomyelitis: 1. Plan of Controlled Field Tests and Results of the 1951 Pilot Study in Utah." *JAMA* 150 (1952): 739–749; Hammon, W. M., L. L. Coriell, and J. Stokes Jr. "Evaluation of Red Cross Gamma Globulin as a Prophylactic Agent for Poliomyelitis: 2. Conduct and Early Followup of 1952 Texas and Iowa-Nebraska Studies." *JAMA* 150 (1952): 750–756; Hammon, W. M., L. L. Coriell, P. F. Wehrle, C. R. Klimt, J. Stokes Jr. "Evaluation of Red Cross Gamma Globulin as a Prophylactic Agent for Poliomyelitis: 3. Preliminary Report of Results Based on Clinical Diagnoses." *JAMA* 150 (1952): 757–760; Hammon, W. M., L. L. Coriell, P. F. Wehrle, J. Stokes Jr. "Evaluation of Red Cross Gamma Globulin as a Prophylactic Agent for Poliomyelitis: 4. Final Report of Results Based on Clinical Diagnoses." *JAMA* 151 (1953): 1272–1285; Hammon, W. M., L. L. Coriell, E. H. Ludwig, R. M. McAllister, A. E. Greene, G. E. Sather, and P. F. Wehrle. "Evaluation of Red Cross Gamma Globulin as a Prophylactic Agent for Poliomyelitis: 5. Reanalysis of Results Based on Laboratory-Confirmed Cases," *JAMA* 156, 1 (1954): 21–27.

³⁵ "Tests Show Injections Protect Children From Paralytic Polio," *El Paso Herald-Post*, October 22, 1952, p. 1.

³⁶ Mawdsley, *Selling Science*, Chapter 6.

³⁷ Rex Thomas, "Important Experiment," *Lethbridge Herald*, July 2, 1953, p. 24.

³⁸ "Miracle Medicine Hopes to Blunt Polio Epidemics," *Brandon Daily Sun*, May 27, 1953, p. 12.

³⁹ "Canada To Test U.S.-Developed Polio Treatment," *Winnipeg Free Press*, February 5, 1953, p. 21. Greg Donaghy, *Grit: The Life and Politics of Paul Martin Sr.* (Vancouver: UBC Press, 2015).

⁴⁰ "Canada To Test U.S.-Developed Polio Treatment," *Winnipeg Free Press*, February 5, 1953, p. 21.

⁴¹ Layton to Davidson, July 15, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, Library and Archives Canada, Ottawa (henceforth LAC).

⁴² Meeting Minutes of FGGAC, January 5, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC.

"Blood Donor Clinic Here in November," *Didsbury Pioneer*, November 18, 1953, Page 7.

⁴³ "Polio Serum Not Being Sold for Exorbitant Price," *Brandon Daily Sun*, August 19, 1953, p. 5; "To test Gama Globulin [sic.] as Polio Protection," *Brandon Daily Sun*, January 29, 1953, p. 11.

⁴⁴ William Hammon, P. H. Kiem, and Iris Kiem, August 23, 1953, "Preliminary Report on Evaluation of Gamma Globulin in the Control of Poliomyelitis Among Household Contacts During the Winnipeg Epidemic in 1953," Government Relations (Foreign), Box 1, Series 1: Country Files, Canada, Polio Epidemic, 1942-1953, MDA.

⁴⁵ "Gamma Globulin Distribution," August 26, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC.

⁴⁶ GG, Box 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC; GG, Box 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin. 1952-1953, LAC; GG, Box 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC; GG, Box 201, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1955, LAC.

⁴⁷ Editorial, "Gamma Globulin in Poliomyelitis," *Can Med Assoc J.* 68, 4 (Apr 1953): 390-391; Editorial, "Poliomyelitis," *Can Med Assoc J.* 69, 1 (Jul 1953): 72-74.

⁴⁸ "US Doctor Tells Convention Serum for Polio Discovered But Risks Prohibit Its Use," *Brandon Daily Sun*, June 20, 1953, p. 9.

⁴⁹ "To Test Gama Globulin [sic.] as Polio Protection," *Brandon Daily Sun*, January 29, 1953, p. 11.

⁵⁰ "Polio Serum May Be Story of the Year," *Brandon Daily Sun*, Oct 1, 1953, p. 2.

⁵¹ "May Be Polio Cure If Parents Will Take a Chance," *Lethbridge Herald*, April 19, 1953, p. 20.

⁵² "Blood Donor Clinic Here in November," *Didsbury Pioneer*, November 18, 1953, p. 7.

⁵³ Black to Layton, June 23, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC.

⁵⁴ Ritch to Layton, "Poliomyelitis - Whitehorse, YT," June 4, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC; Smith to Young, June 4, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1953, LAC.

⁵⁵ "Thirty-Three News Cases of Polio Reported," *Brandon Daily Sun*, July 30, 1953, p. 1; Leah Morton, "From Nose Sprays to Nursing Shortages: Managing Epidemic Polio in Manitoba, 1928-1953," *Manitoba History*, 66 (Spring 2011): 20-21; Leah Morton, "'It has impacted our lives in great measure': Families, Patients, and Health Care during Manitoba's Polio Era, 1928-1953" (PhD Diss. University of Manitoba, 2013).

⁵⁶ Liz Katynski, "Doc recalls province's worst polio epidemic in 1953," *Winnipeg Free Press*, May 28, 2003.

-
- ⁵⁷ "Preventative for Polio Available," *Winnipeg Free Press*, July 13, 1953, p. 1.
- ⁵⁸ R. G. Cadham, "The Poliomyelitis Epidemic in Winnipeg, 1953: Epidemiological Study, Including the Use of Gamma Globulin," *Canadian Journal of Public Health* 45, 5 (May 1954), pp. 185-194
- ⁵⁹ William Hammon, P.H. Kiem, and Iris Kiem, August 23, 1953, "Preliminary Report on Evaluation of Gamma Globulin in the Control of Poliomyelitis Among Household Contacts During the Winnipeg Epidemic in 1953," Government Relations (Foreign), Box 1, Series 1: Country Files, Canada, Polio Epidemic, 1942-1953, MDA.
- ⁶⁰ Elliott to Layton, August 25, 1953, RG29 199, Epidemiology: Diseases - Poliomyelitis - Gamma Globulin, 1952-1953, LAC.
- ⁶¹ "Mulligan Would Seek U.S. Serum," *Winnipeg Free Press*, August 5, 1953, p. 1.
- ⁶² "Blood Donors Urgently Needed," *Manitoba Leader*, November 26, 1953, p. 1.
- ⁶³ "Brandon Urged to Give Blood to Combat Ravages of Polio," *Brandon Daily Sun*, December 7, 1953, p. 1.
- ⁶⁴ "Brandon Urged to Give Blood to Combat Ravages of Polio," *Brandon Daily Sun*, December 7, 1953, p. 1.
- ⁶⁵ "City Warned Against Polio Serum Pedlars," *Winnipeg Free Press*, August 10, 1953, pp. 1, 9.
- ⁶⁶ "City Warned Against Polio Serum Pedlars," *Winnipeg Free Press*, August 10, 1953, pp. 1, 9.
- ⁶⁷ "Picked Up in Passing," *Lethbridge Herald*, August 3, 1953, p. 4.
- ⁶⁸ "Letters to the Editor: Gamma Globulin," *Winnipeg Free Press*, September 16, 1953, p. 24.
- ⁶⁹ "Manitoba Polio Count Near Mark," *Brandon Daily Sun*, August 23, 1954, p. 1.
- ⁷⁰ "Labor Asks Govt. Control of Polio Drug," *Winnipeg Free Press*, August 3, 1953, p. 6.
- ⁷¹ "Polio Serum Not Being Sold for Exorbitant Price," *Brandon Daily Sun*, August 19, 1953, p. 5.
- ⁷² "Labor Asks Govt. Control of Polio Drug," *Winnipeg Free Press*, August 3, 1953, p. 6.
- ⁷³ "Sale of Polio Serum Ruled Legitimate," *Lethbridge Herald*, August 8, 1953, p. 11.
- ⁷⁴ "Manitoba Polio Count Near Mark," *Brandon Daily Sun*, August 23, 1954, p. 1.
- ⁷⁵ "Polio Cost Province \$485,000, Says Bell In Defence Of Govt.," *Winnipeg Free Press*, February 16, 1954, p. 7; Minutes of the FGGAC, March 5, 1954, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC.
- ⁷⁶ "Health Deputy Hits Press For 'Overplaying' Polio," *Winnipeg Free Press*, March 15, 1954, p. 1.
- ⁷⁷ "Bell Defends Polio Action of Province," *Brandon Daily Sun*, February 16, 1954, p. 2.

-
- ⁷⁸ “Polio Death Toll: Eighty-Eight Lives Lost So Far This Year in Canada,” *Brandon Daily Sun*, August 25, 1953, p. 1.
- ⁷⁹ Russell F. Taylor, *Polio '53: A Memorial for Russell Frederick Taylor* (Edmonton: University of Alberta Press, 1990), p. 16.
- ⁸⁰ “New Outbreak of Polio In Alberta Caused Small Panic Among Edmonton Parents,” *Brandon Daily Sun*, November 18, 1953, p. 9.
- ⁸¹ “Blood Donor Clinic Here in November,” *Didsbury Pioneer*, November 18, 1953, p. 7.
- ⁸² Editorial, *Recorder*, February 26, 1954, p. 8.
- ⁸³ “To Hold Blood Donor Clinic Here on December 10th,” *Didsbury Pioneer*, December 2, 1953, p. 1.
- ⁸⁴ “To Hold Blood Donor Clinic Here on December 10th,” *Didsbury Pioneer*, December 2, 1953, p. 1.
- ⁸⁵ “To Hold Blood Donor Clinic Here on December 10th,” *Didsbury Pioneer*, December 2, 1953, p. 1.
- ⁸⁶ “Still Need Donors for Clinic,” *Lethbridge Herald*, March 5, 1954, p. 9.
- ⁸⁷ “War Declaration Coming Start Legion Appeal,” *Medicine Hat News*, January 12, 1954, p. 3.
- ⁸⁸ “Legion Polio Campaign to Continue Through Feb.,” *Didsbury Pioneer*, February 10, 1954, p. 1.
- ⁸⁹ “Legion Polio Campaign to Continue Through Feb.,” *Didsbury Pioneer*, February 10, 1954, p. 1.
- ⁹⁰ “Donor Enrollment Office,” *The Gateway*, February 4, 1954, p. 2.
- ⁹¹ Elise A. Corbet, *Frontiers of Medicine: A History of Medical Education and Research at the University of Alberta* (University of Alberta Press, 1990), p. 125. See also “Campus Claims Corpuscle Cup,” *Dalhousie Gazette*, 3 February 1953, p. 1.
- ⁹² “Think! – Act!” *The Gateway*, January 14, 1954, p. 2.
- ⁹³ “Think! – Act!” *The Gateway*, January 14, 1954, p. 2.
- ⁹⁴ Corbet, *Frontiers of Medicine*, p. 125. “Red Cross Campaign for Blood to Aim at 2,000 Donors,” *The Gateway*, January 14, 1954, p. 1.
- ⁹⁵ “Donor Enrollment Office,” *The Gateway*, February 4, 1954, p. 2.
- ⁹⁶ “Three-year-old Jeanie,” *Didsbury Pioneer*, June 2, 1954, p. 3.
- ⁹⁷ “Red Cross Meets Blood Quota for Gamma Globulin,” *Medicine Hat News*, February 22, 1954, p. 3.

-
- ⁹⁸ Minutes of the FGGAC, March 5, 1954, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC.
- ⁹⁹ Minutes of the FGGAC, March 5, 1954, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC.
- ¹⁰⁰ "N.Y. Officials Stress Polio Serum Unproved," *Winnipeg Free Press*, September 5, 1953, p. 34.
- ¹⁰¹ "Find Results Polio Serum Inconclusive," *Brandon Daily Sun*, February 24, 1954, p. 1.
- ¹⁰² "Gamma Globulin May Be Too Slow, Experts Warn," *Winnipeg Free Press*, September 21, 1953, p. 4.
- ¹⁰³ "Buy Enough Vaccine to Treat 29,000," *Lethbridge Herald*, June 24, 1954, p. 2.
- ¹⁰⁴ "Anti-Polio Treatment Costs High," *Winnipeg Free Press*, October 15, 1953, pp. 1, 31.
- ¹⁰⁵ "Gamma Globulin Effective Against Poliomyelitis," *Roblin Review and Togo News*, July 5, 1954, p. 4.
- ¹⁰⁶ "Canadian Has Good Word for Polio Serum," *Brandon Daily Sun*, February 25, 1954, p. 9.
- ¹⁰⁷ Minutes of the FGGAC, October 27, 1954, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC; Minutes of the FGGAC, March 5, 1954, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC.
- ¹⁰⁸ "Polio Assumes New Prominence Martin Declares," *Lethbridge Herald*, December 4, 1953, p. 16; "Federal Aid: Provinces to Have Larger Supply Anti-Polio Serum," *Brandon Daily Sun*, December 3, 1953, p. 1.
- ¹⁰⁹ "Federal Aid: Provinces to Have Larger Supply Anti-Polio Serum," *Brandon Daily Sun*, December 3, 1953, p. 1.
- ¹¹⁰ "Polio Assumes New Prominence Martin Declares," *Lethbridge Herald*, December 4, 1953, p. 16
- ¹¹¹ Paul Martin, "First National Report on Gamma Globulin," October 1, 1953, RG29 204, Epidemiology: Gamma Globulin Advisory Committee, 1953-1956, LAC.
- "Polio Serum May Be Story of the Year," *Brandon Daily Sun*, October 1, 1953, p. 2.
- ¹¹² "Federal Aid: Provinces to Have Larger Supply Anti-Polio Serum," *Brandon Daily Sun*, December 3, 1953, p. 1.
- ¹¹³ "Anti-Polio Serum," *Lethbridge Herald*, July 7, 1954, p. 14.
- ¹¹⁴ "Gamma Globulin Soon Will Be Available on Doctor's Prescription," *Lethbridge Herald*, June 30, 1954, p. 19.
- ¹¹⁵ "City Stores Now Selling Polio Serum," *Winnipeg Free Press*, June 29, 1954, p. 1.
- ¹¹⁶ "Gamma globulin – what is it?" *Chronicle*, June 17, 1954, p. 8.
- ¹¹⁷ "How the Blood Transfusion Service Operates in Saskatchewan," *Chronicle*, March 4, 1954, p. 2.

¹¹⁸ “Cannot Protect All Children with Gamma Globulin,” *Lethbridge Herald*, February 22, 1954, p. 16.

¹¹⁹ “Gamma globulin Still Not Proven,” *Chronicle*, July 22, 1954, p. 3.

¹²⁰ “Health League Backs Doctor in Decision,” *Brandon Daily Sun*, July 17, 1954, p. 5.

¹²¹ “Salk Vaccine Against Polio Has Unlimited Possibilities,” *Brandon Daily Sun*, September 9, 1954, p. 12.

¹²² Smith and Mawdsley, “Alberta Advantage” in *Locating Health*, p. 89.

¹²³ Smith and Mawdsley, “Alberta Advantage” in *Locating Health*, p. 89.

¹²⁴ Oshinsky, *Polio an American Story*, Chapter 12; Mawdsley, *Selling Science*, Chapter 6.